



# **Armed Forces College Of medicine AFCM**

*Sending you  
millions of smiles!  
Take one each  
morning, because  
**I want to see you  
smiling always.**  
Have a blessed day.  
Good Morning*





# **Pathology of ischemic heart diseases**

***Prof. Eman Abdelbary***

# Intended Learning Objectives (ILOs)



**By the end of this lecture, the student will be able to:**

1. Identify causes, pathology and effects of cardiac ischemia
2. Summarize pathogenesis, pathological features and complications of cardiac ischemia
3. Correlate between etiology, pathogenesis, pathological features, investigations and complications of cardiac ischemia

# Lecture plan



1. Part 1 (10 min): Pathology of chronic ischemic heart disease
2. Part 2 (10 min): Definition, types of angina pectoris
3. Part 3 (20 min): Pathology of myocardial infarction
4. Lecture Quiz (5 min)

# Chronic ischemic heart diseases



## *Synonyms:*

- ✓ Incomplete coronary insufficiency
- ✓ Arteriosclerotic heart disease (in case of atherosclerosis)

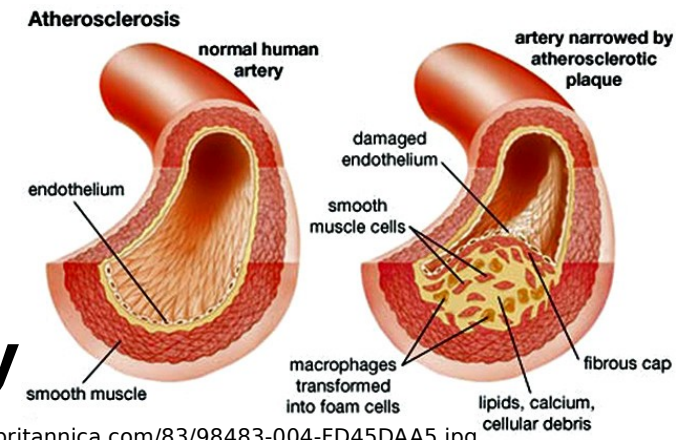
## *Causes:*

1- Coronary atherosclerosis (**90% of cases**) → Incomplete gradual coronary occlusion (A fixed lesion **obstructing** > 75% of vascular cross section).

2- Others: - Aortic stenosis/ incompetence

- Anemia, lung fibrosis

- Tachycardia, myocardial hypertrophy



# Chronic ischemic heart disease



## ***Pathology:***

- 1- Patchy myocardial fibrosis (healing of necrotic muscle fibers)**
- 2- Patchy endocardial thickening & fibrosis**
- 3- Mitral & aortic valve thickening and calcification, normal chordae tendinae**
- 4- Mural thrombi may be present**





# Chronic ischemic heart diseases



## ***Effects:***

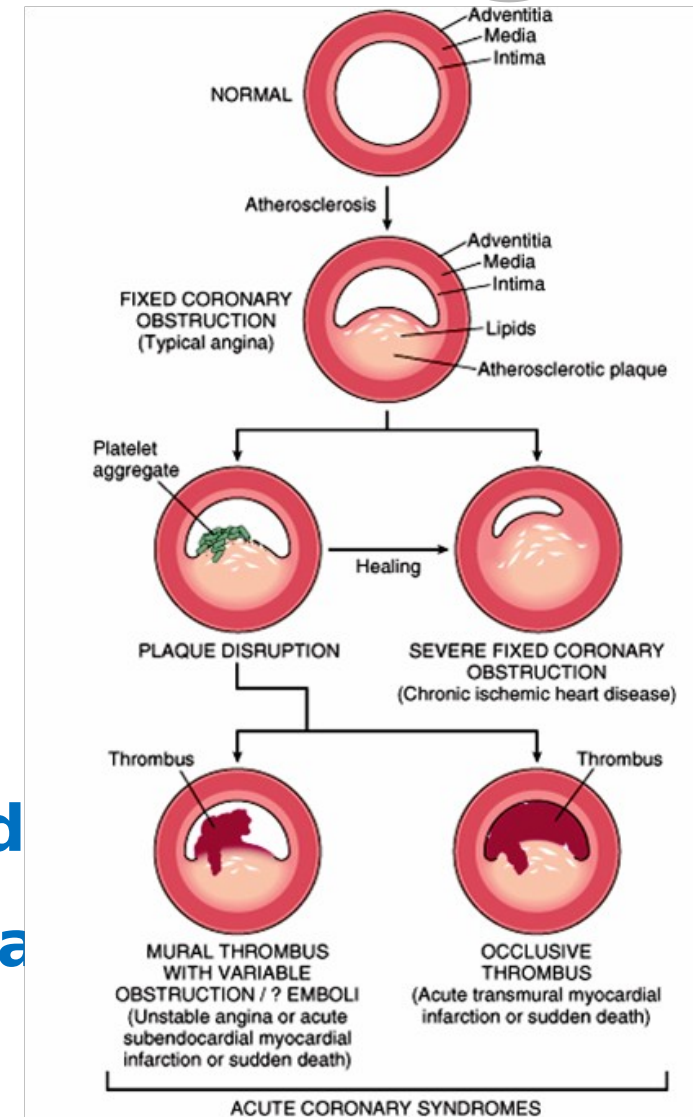
**1- Angina pectoris**

**2- Arrhythmias:** Due to affection of conductive system

**3- Chronic heart failure:** Due to progressive fibrosis of affected ventricle

**4- Coronary atherosclerosis predispose to sudden complete occlusion**

**Acute cardiac ischemia**



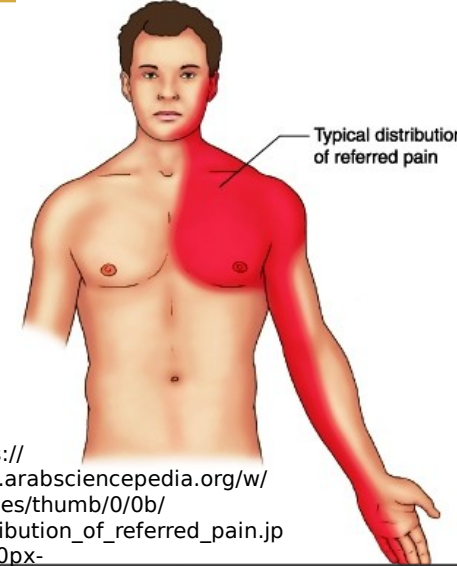


# Chronic ischemic heart diseases

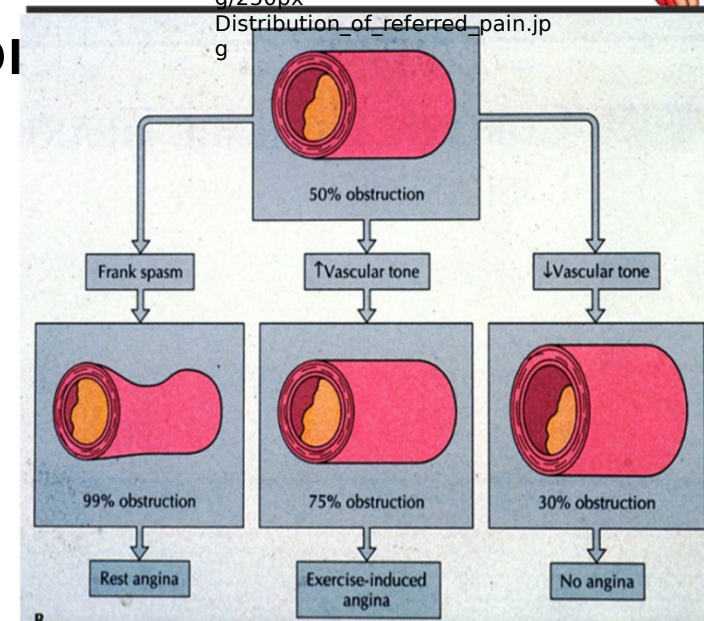


## Angina pectoris:

- **Definition:** Intermittent chest pain caused by **transient, reversible** myocardial ischemia
- **Clinically:** Attacks of crushing or squeezing retrosternal pain, radiating down the left arm or the left jaw.
- Typically responds to vasodilators.



[https://www.arabsciencepedia.org/w/images/thumb/0/0b/Distribution\\_of\\_referred\\_pain.jpg/250px-Distribution\\_of\\_referred\\_pain.jpg](https://www.arabsciencepedia.org/w/images/thumb/0/0b/Distribution_of_referred_pain.jpg/250px-Distribution_of_referred_pain.jpg)



# Chronic ischemic heart diseases



## Angina pectoris:

### *Types:*

**1. *Typical (stable) angina:*** Attacks precipitated by physical effort / psychological stress & disappear on rest.

➤ Due to **coronary atherosclerosis with luminal narrowing  $> 75\%$**

# Chronic ischemic heart diseases



## Angina pectoris: *Types: cont.*

### ***2. Unstable (Crescendo) angina:***

**Attacks occur in increasing frequency & duration.**

**May occur at rest or after minimal effort.**

**Due to non occlusive thrombus on top of atherosclerosis.**

### ***3. Prinzmetal's angina:*** Occurs at rest, unrelated to physical effort.

**Due to coronary vasospasm.**

## ***Pathology of chronic ischemic heart diseases (Quiz)***



**List the possible effects of chronic cardiac ischemia?**

- 1- Angina pectoris**
- 2- Arrhythmias: Due to affection of conductive system**
- 3- Chronic heart failure: Due to progressive fibrosis of affected ventricle**
- 4- Coronary atherosclerosis predispose to sudden complete occlusion & Acute cardiac ischemia**

# Acute ischemia (Complete coronary occlusion)

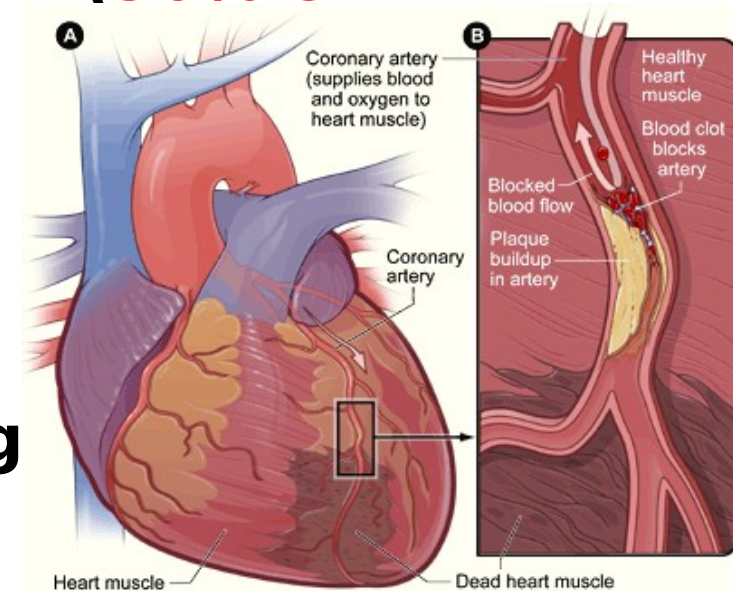
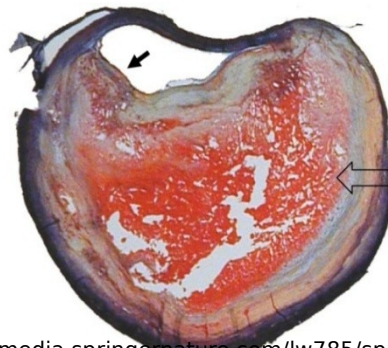
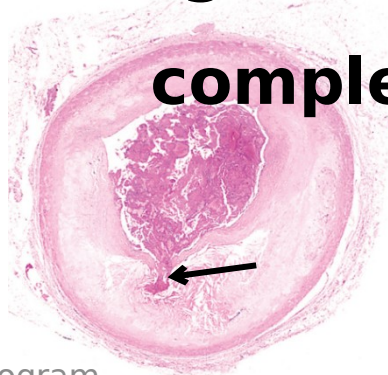


## ***Causes:***

**1- Coronary atherosclerosis + complete occlusion (90% of cases) due to:**

- Advanced atherosclerosis
- Thrombosis over an atheroma →
- Intimal hemorrhage in an atheroma →

**the atheroma complete occ**



**lifting**

# **Acute ischemia**

## **(Complete coronary occlusion)**



### ***Causes:***

#### **2- rare causes:**

- **Sever coronary spasm**
- **Sever hypotension**
- **Coronary embolism**
- **Dissecting aneurysm if reaching coronary ostia.**

# Acute ischemia

## (Complete coronary occlusion)



### ***Effects:***

- 1. Myocardial infarction.**
- 2. Acute heart failure.**
- 3. Sudden death (50%) due to ventricular fibrillation.**



# Myocardial infarction



***Definition:*** Death of a part of the myocardial muscle due to sudden complete occlusion of a coronary artery.

- ***Clinically:*** Prolonged crushing, stabbing or squeezing retrosternal pain, radiating down the left arm or to the left jaw + rapid weak pulse + profuse sweating + nausea & vomiting .

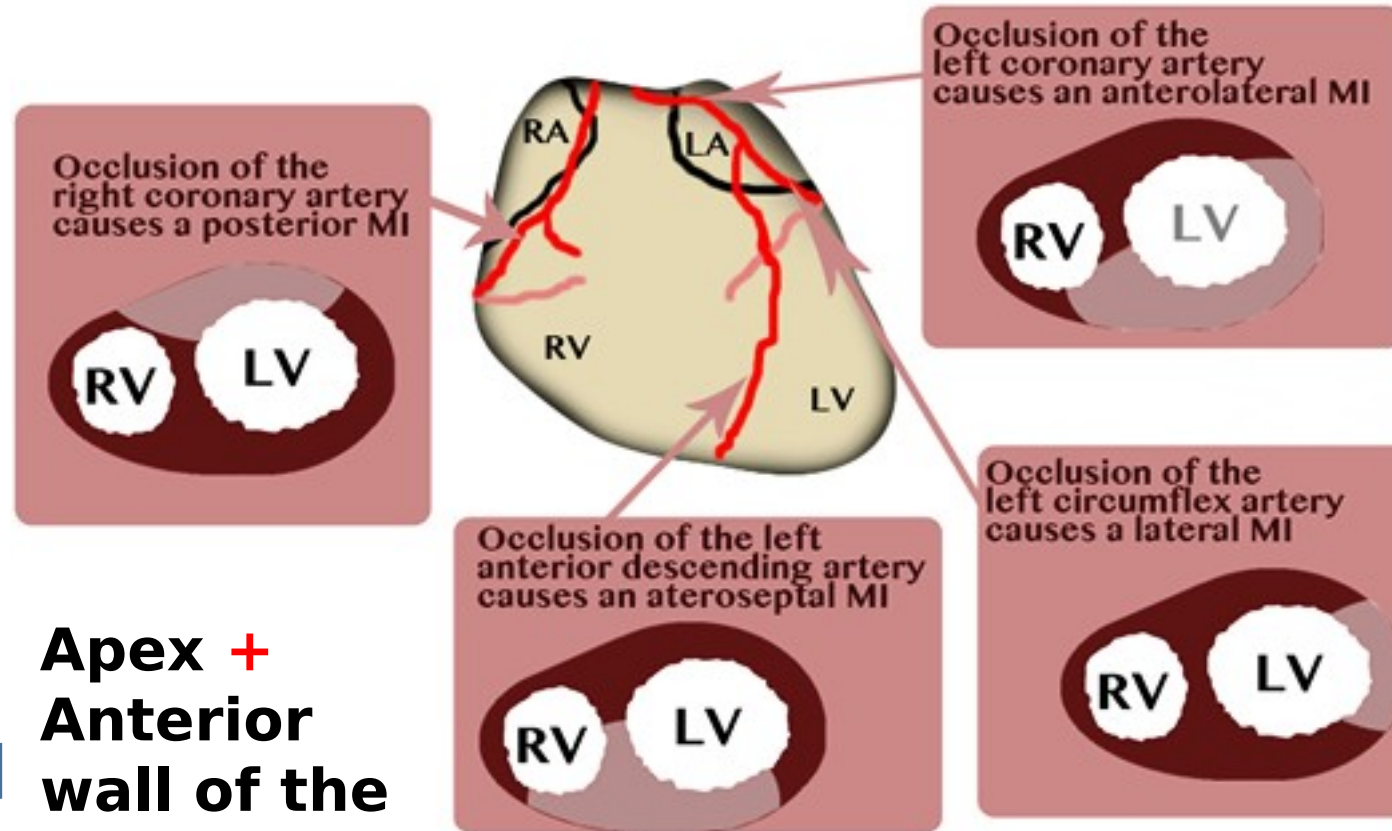


# Myocardial infarction



## *Sites:*

**Rt.  
Ventricle +  
Posterior  
wall of the  
Lt. ventricle  
+ posterior  
part of the  
septum**



**Apex +  
Anterior  
wall of the  
Lt.  
Ventricle +  
anterior  
part of the**

**Lateral wall  
of the Lt.  
Ventricle**

*Most  
common*

# Myocardial infarction



## *Types :*

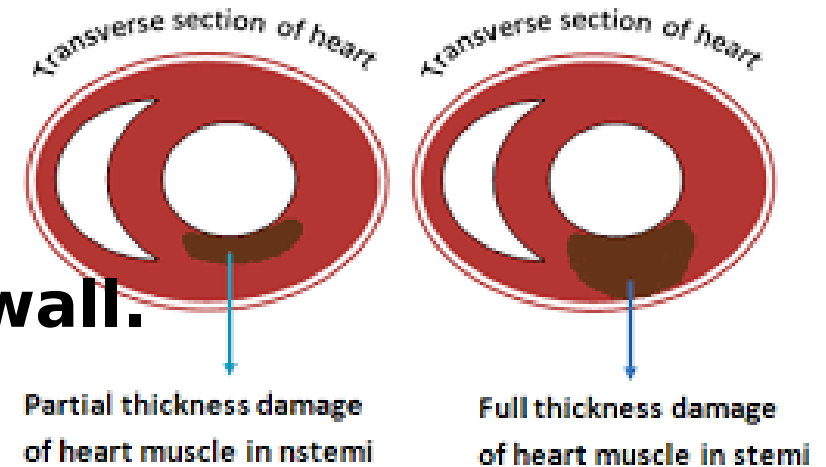
### *1- Transmural infarction:*

Involves the **full thickness** of ventricular wall.

### *2- Subendocardial infarction:*

❑ Limited to the **inner 1/3 to 1/2** of the ventricular wall.

❑ Due to vasospasm, hypotension or a thrombus that becomes lysed before necrosis involves the **whole thickness of myocardium**.



[https://www.researchgate.net/profile/Patricia\\_Mergo/publication/233766843/figure/fig1/AS:643938897641489@1530538405910/Subendocardial-versus-transmural-myocardial-infarction-During-a-myocardial-infarction.png](https://www.researchgate.net/profile/Patricia_Mergo/publication/233766843/figure/fig1/AS:643938897641489@1530538405910/Subendocardial-versus-transmural-myocardial-infarction-During-a-myocardial-infarction.png)

# Myocardial infarction



## **Pathology:** ■ Gross

<b>Healed infarction</b>	<b>Recent infarction</b>
<b>Fibrous healing within 4-8 weeks</b>	<b>Changes appear after 6-8 h from onset of infarction</b>
<b>Infarct: thin, gray, fibrotic, may dilate (cardiac aneurysm)</b>	<b>Infarct: swollen, pale, friable, may rupture, hyperemic margins</b>
<b>Mural thrombus is organized</b>	<b>Mural thrombus may occur</b>



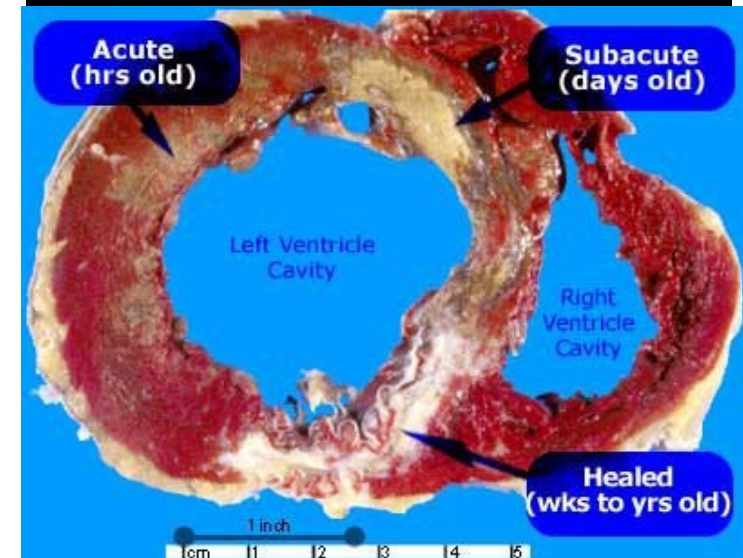
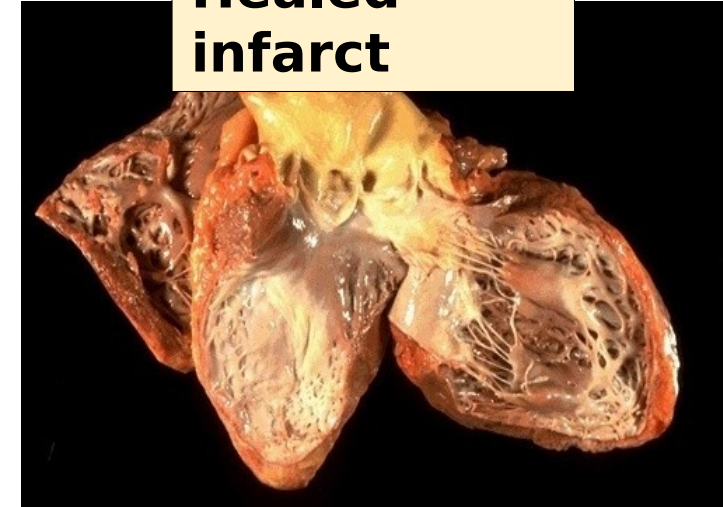
# Myocardial infarction



**Recent infarct**



**Healed infarct**



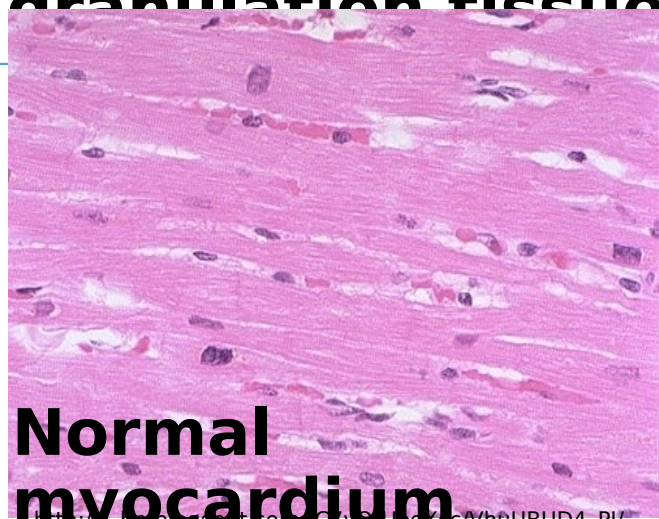


# Myocardial infarction



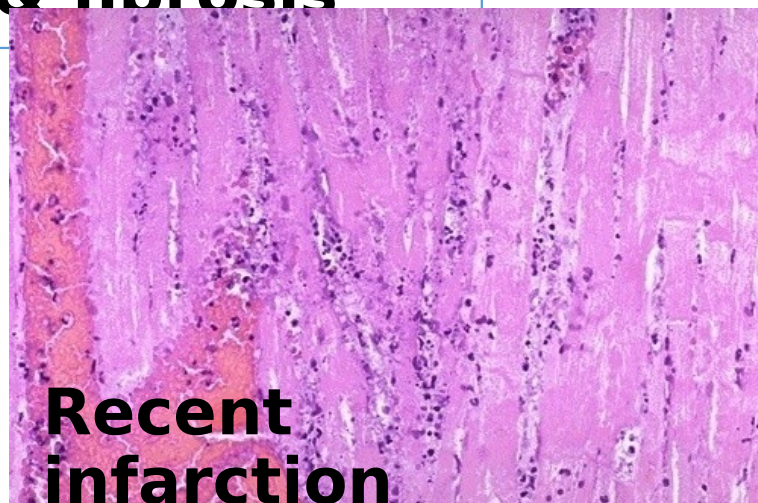
## **Pathology:** ▣ Microscopic

<b>Healed infarction</b> picture!	<b>Recent infarction</b>
	<b>Changes appear earlier than gross changes</b>
<b>Necrotic muscles engulfed by macrophages, Followed by formation of granulation tissue &amp; fibrosis</b>	<b><i>Coagulative necrosis:</i> Infiltrated by neutrophils followed by macrophages</b>



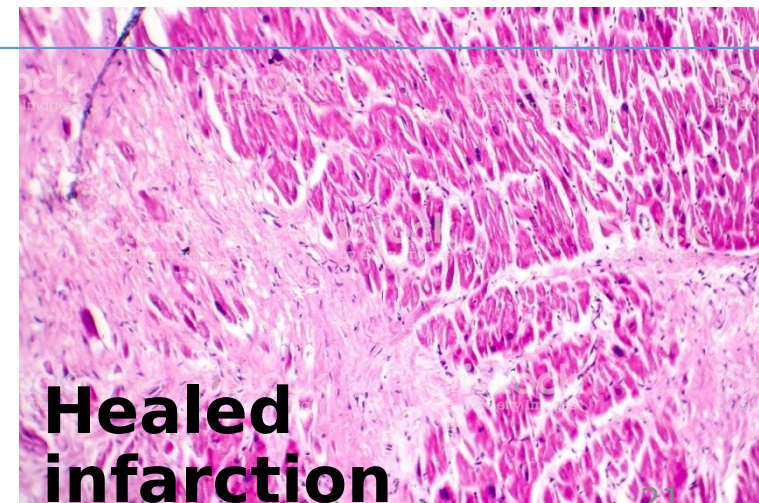
**Normal  
myocardium**

[http://i.blogs.pot.com/CryQUseKec/VhuUBUD4\\_PI/AAAAAAAAAWo/KOtVov7vGF0/s1600/01-myocardec.jpg](http://i.blogs.pot.com/CryQUseKec/VhuUBUD4_PI/AAAAAAAAAWo/KOtVov7vGF0/s1600/01-myocardec.jpg)



**Recent  
infarction**

(Cardio Pulmonary Module)



**Healed  
infarction**

<https://media.istockphoto.com/photos/acute-myocardial-infarction-histology-of-heart-tissue-picture-id992901962>

[https://66.media.tumblr.com/tumblr\\_m5aop8W491mdruwz3\\_250.jpg](https://66.media.tumblr.com/tumblr_m5aop8W491mdruwz3_250.jpg)

# Myocardial infarction



## *General manifestations:*

Healed infarction	Recent infarction
Disappear ↑	Leukocytosis, fever serum enzymes (LDH, CPK, SGOT)



# Myocardial infarction



## ***Fate & complications:***

<b>Healed infarction</b>	<b>Recent infarction</b>
<b>Chronic heart failure</b>	<b>Acute heart failure.</b>
<b>Rupture of cardiac aneurysm hemopericardium &amp; death</b>	<b>Rupture of infarct hemopericardium &amp; death</b>
<b>Arrhythmias: e.g. extra-systoles</b>	<b>Arrhythmias: e.g. ventricular fibrillation., may be fatal</b>
	<b>Death due to cardiogenic shock.</b>

## ***Pathology of myocardial infarction (Quiz)***



**What is the most common site for myocardial infarction?**

- A. Anterior wall of the left ventricle.
- B. Anterior wall of the right ventricle.
- C. Posterior wall of the left ventricle.
- D. Posterior wall of the right ventricle.
- E. Lateral wall of the left ventricle.

## ***Pathology of myocardial infarction (Quiz)***



**What is the most common site for myocardial infarction?**

- A. Anterior wall of the left ventricle.**
- B. Anterior wall of the right ventricle.
- C. Posterior wall of the left ventricle.
- D. Posterior wall of the right ventricle.
- E. Lateral wall of the left ventricle.

## ***Key points:***



- Coronary atherosclerosis is the most common cause of cardiac ischemia
- Angina pectoris is intermittent chest pain caused by **transient, reversible** myocardial ischemia, typically responds to vasodilators
- Types of angina are stable, unstable and Prinzmetal's
- The most common site for myocardial infarction is the apex, anterior wall of the Lt. Ventricle and anterior part of the septum
- Myocardial infarction may be transmural or subendocardial
- The pathological features of recent myocardial infarction are that of coagulative necrosis, while healed infarction is characterized by fibrous scarring

# Suggested Textbooks



1. Mitchell R. Blood vessels. In Robbins and Cotran pathologic basis of disease, 10<sup>th</sup> edition. Kumar, Abbas & Aster (eds). Elsevier Saunders. Pages 487 to 491.
2. Cardiac pathology. In USMLE step 1 lecture notes, 2017. Kaplan INC, New York. Pages 112 -125

